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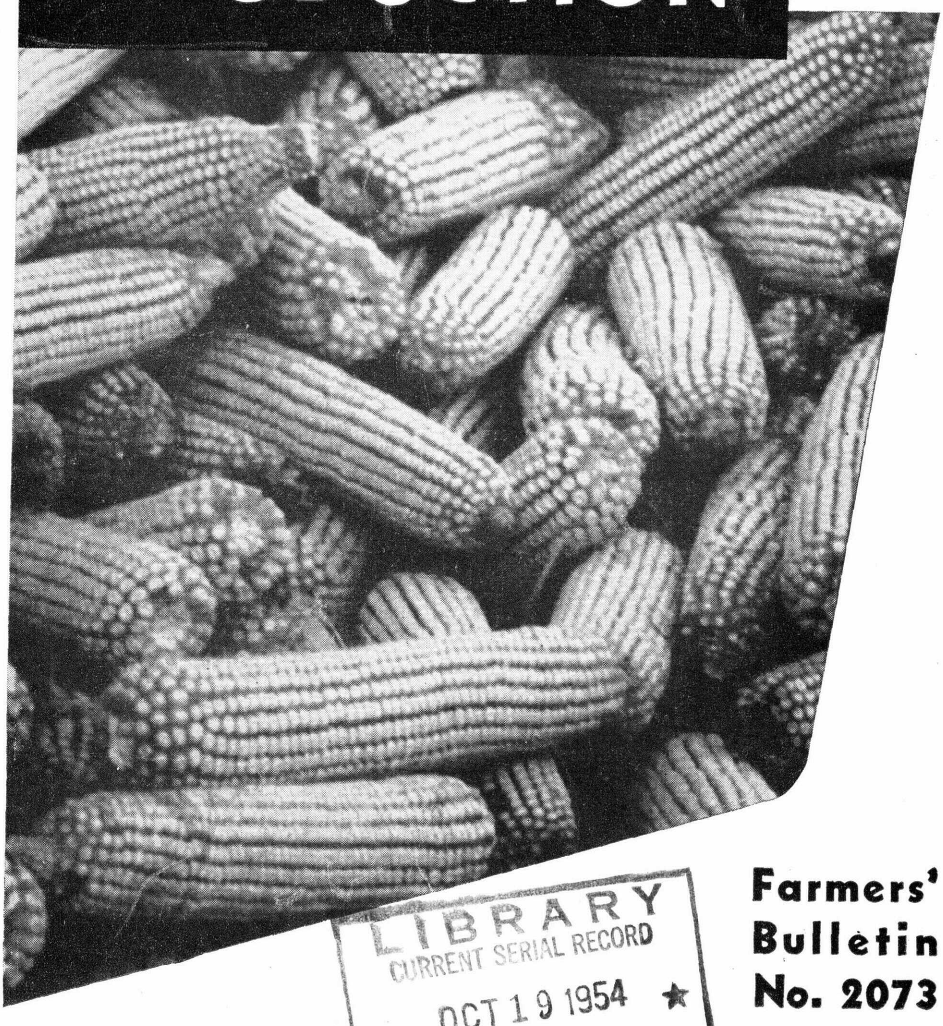
CORN PRODUCTION



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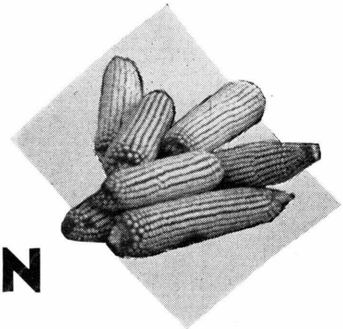

CORN PRODUCTION

By G. H. Stringfield, *senior agronomist, Field Crops Research Branch*, and M. S. Anderson, *senior chemist, Soil and Water Conservation Research Branch, Agricultural Research Service*

A SWEEPING change in the production of corn has occurred during the last 20 years. This change has been brought about by the introduction and widespread use of adapted hybrids, the greater use of balanced fertilizers, heavier planting rates, and the mechanization of the crop on the family-size farm.

Acre yields have increased sharply. Before 1940 the longtime average yield in the Nation was about 26 bushels per acre. For the 4-year period, 1949–52, the national average has been about 38 bushels.

This increase in yield has been possible because an increasing number of farmers have applied a combination of highly effective practices on their cornland. This combination of practices includes most or all of the following:

(1) Planting adapted hybrid seed corn.
(2) Use of fertilizer to meet the requirements of the soil.
(3) Adjustment of stand to soil fertility and moisture.
(4) Efficient use of machinery.
(5) Good crop rotations and soil-building practices.
(6) Improved weed, insect, and disease control.
(7) Good timing of all production operations, including seedbed preparation, cultivation, and harvesting.

On farms where these combined practices have been adopted, corn yields average more than twice as much as the national average. As more farmers use these practices, the national average can be expected to rise higher, perhaps to almost double the present level. In the Corn Belt (fig. 1), a yield of 100 bushels to the acre is already common on many farms.

HYBRID CORN

Hybrid corn is a remarkable achievement in agricultural research. Because of it, farmers of the Nation are now growing more corn on fewer acres than farmers were using 60 years ago (fig. 2).

Corn breeders in the United States Department of Agriculture, in State agricultural experiment stations, and in private industry are not only directing their work toward the production of higher yielding hybrids but they are working to improve other characteristics of the corn plant. Here are a few examples:

(1) Most of the corn now grown in the Corn Belt has been bred to possess strong stalks and roots that will keep the plants upright far into the fall. This is of great importance in mechanical harvesting.

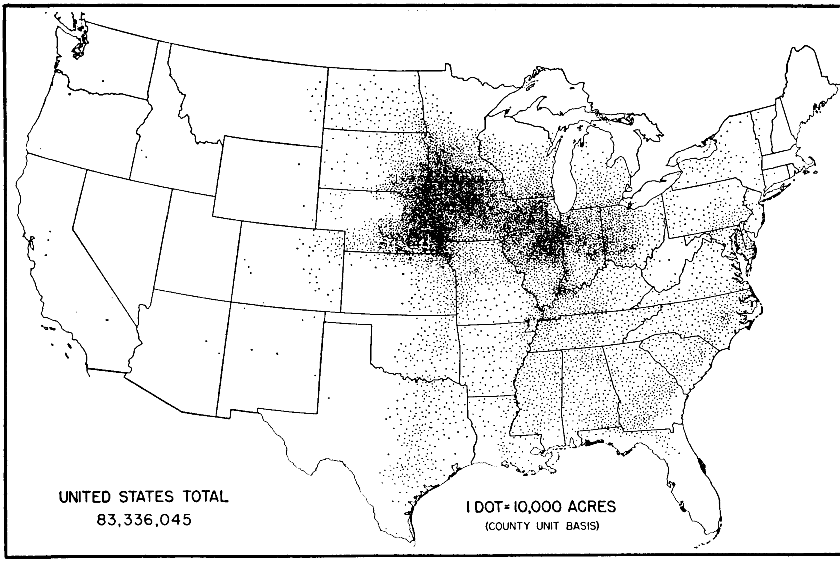

FIGURE 1.—Acreage in corn in the United States, 1949 (U. S. Bureau of the Census). The Corn Belt includes the area where the dots are thickest, extending from Ohio to Nebraska and from southern Minnesota to northern Missouri.

(2) Drought resistance has been bred into many hybrids as a result of the hot, dry summers that occurred in the 1930's.

(3) Some hybrids have been bred for resistance to various diseases and to attacks from insects.

Corn breeders are developing hybrids for adaptation to almost every area of the United States where corn can be grown at least fairly well. In addition to the Corn Belt hybrids, there are hybrids for the longer growing seasons of the South and Southwest. Hybrids have

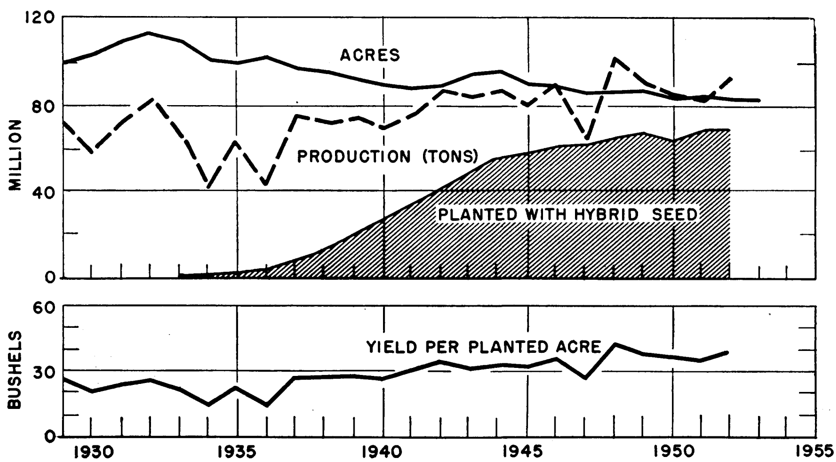

FIGURE 2.—Since the introduction of hybrids, the total acreage planted to corn in the United States has decreased but the total production and yield per acre have increased.

also been developed for areas in the North where the growing season is much shorter.

Hybrid corn varieties, in brief, are tailormade to meet the climatic and soil conditions of particular areas. A high-yielding hybrid in Iowa might succumb to insects or diseases in Alabama, to leaf blights or stalk rots in Ohio, to early frosts in Wisconsin, or to heat in Oklahoma. Ranges of adaptability of hybrid varieties often are so limited that a high-yielding hybrid in one section of a State will return low yields in another section of the same State.

Because a grower will obtain best results from an adapted hybrid, he should consult his county agent to determine the hybrids that are known to be adapted to his particular locality.

Choosing Good Hybrid Seed Corn

To make certain he is getting good seed of vigorous, well-adapted hybrids that can withstand the climate, insects, and diseases in his locality, the grower needs information on these seven points:

1. How does the hybrid compare with other varieties in its capacity to produce high yields of sound corn on standing stalks? A dependable hybrid will have a record of performance in experimental plots and probably on a field basis on farms in the locality.

2. Does it have the right seasonal requirement, that is, is it early enough to mature properly and late enough to make good use of the normal growing season? This is especially important in the northern half of the United States.

3. Was the seed produced in good isolation, with thorough detasseling, care in harvesting, and with attention to approved methods in general? Assurance on this item, to an even greater extent than the two foregoing items, may have to depend on confidence in the seed producer. These qualities ordinarily cannot be recognized by looking at the seed. Typical field conditions for producing good seed corn are shown in figure 3.

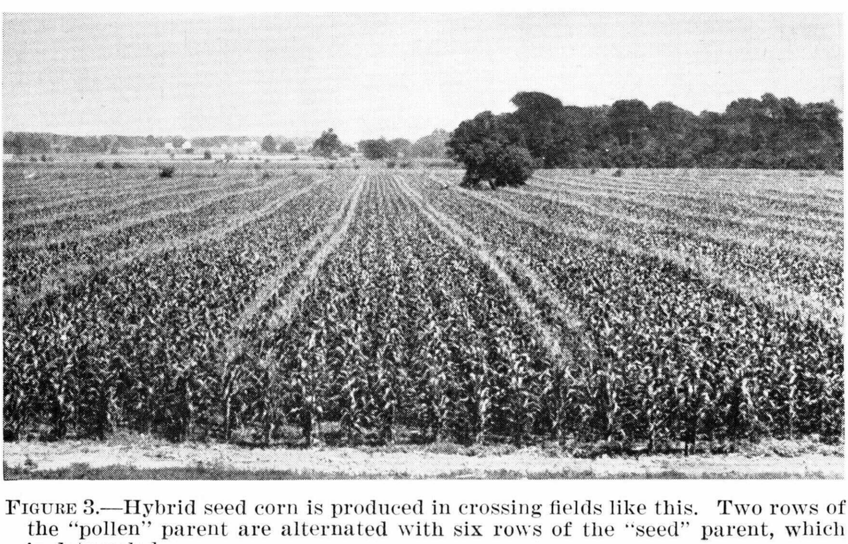

FIGURE 3.—Hybrid seed corn is produced in crossing fields like this. Two rows of the "pollen" parent are alternated with six rows of the "seed" parent, which is detasseled.

4. Is the seed in sound physical condition? The seeds should be smooth, plump, and bright, indicating good health. They should also be well filled at the crown ends to indicate complete maturity. If the seedcoats have a tendency to raise in blisters, especially over the germ, or if many corners and crowns are chipped, it may pay to look for other sources before buying. Any break in the seedcoat is a likely spot for infection. This includes tiny breaks too small to be seen by the naked eye. It is therefore wise to examine seed corn with a magnifying glass.

5. Has the seed been chemically treated? Treatment with an effective fungicide is a partial but valuable insurance for early (cool-soil) planting, or for scuffed, immature, or otherwise weak seed. The addition of DDT to the fungicide provides protection against stored-grain insects. Seed treatment, however, may delay germination in dry soil, and overtreatment with mercurial compounds may result in distorted seedlings.

6. Does the seed have good and uniform size and shape? Other things being equal, large seed will emerge sooner, produce a stronger seedling, and result in maturity 1 to 5 days sooner than small seed. But with ample time for maturity there will be little or no difference in final grain yield. So-called "round" seed gives as good results as flat seed, if equally viable. Uniformity of size and shape is desirable for better control of planting rate.

7. Has the seed been properly stored? In warm, moist storage seed may be seriously weakened in a few weeks or even a few days. In dry, cold storage it will remain highly viable for much longer periods—sometimes for years. Ordinarily, if seed is kept dry and protected from insects, it should stay in satisfactory condition until the second spring after its harvest. The farmer should know that the seed has demonstrated high germinating ability before he receives it. Seed should be kept cool and dry after delivery to the farm.

CLIMATIC REQUIREMENTS

The amount and timeliness of rainfall and the accompanying temperatures are the principal climatic factors that influence the growth of corn. Quality of the soil is also important in modifying the effects of climate. In the Corn Belt climatic and soil conditions are unusually favorable for corn production.

During the month of planting, the chief factor limiting growth is low temperature. Soil moisture, too, plays an important part. Too much rainfall delays planting and cultivation. Seedlings may rot in cold, wet soil. A shortage of soil moisture delays seedling establishment.

Following planting, adequate rainfall and favorable temperatures steadily increase in importance to the corn crop until the plants reach the silking stage. Experiments at the Colorado and Nebraska Agricultural Experiment Stations show that the most critical period in soil moisture usage is just at the tasseling stage—a few days before silking. Hailstorms are most harmful between the periods of jointing and silking.

Higher than average temperatures at pollination time are more likely to be harmful than beneficial to corn. This has been shown in studies at State agricultural experiment stations from Nebraska

and Kansas to Pennsylvania and Maryland. The best antidote for extremely hot midsummer weather is ample soil moisture to keep the corn leaves unrolled, unwilted, and glistening.

Cool wet growing seasons, on the other hand, result in slow growth, late maturity, and often in soft corn at harvesttime.

The need for moisture is reduced by the time the kernels are in the hard-dough stage. At that stage the weather hazards to the crop are mainly storms that may break or uproot the stalks, early low temperatures (40° F. or less), or prolonged cool, wet periods that delay field drying.

While a farmer cannot change the weather, he can create soil and moisture conditions that will help his crop along at critical times.

(1) He can funnel off excessive spring rainfall by installing and maintaining good drainage outlets. This will also promote faster warming of the normally cool soil during the planting season, and, in turn, promote deeper root systems that can draw on a greater reserve of soil moisture at the critical flowering period.

(2) He can maintain and even build up an adequate organic content in the soil by following a good system of rotation which includes sod-forming crops and the use of manure and fertilizers, particularly nitrogen. The greater organic content of the soil will increase its moisture-intake and moisture-holding capacity.

(3) He can conserve water by clean cultivation, strip cropping, terracing, and mulching where these practices are suitable.

(4) He can cultivate his land in such a way as to leave the soil loose and receptive to water, rather than in an overfine or overpacked condition which would promote runoff.

Water conserved that otherwise would be lost will add bushels to the corn crop in all years except those with extremely cold, wet, early growing periods. An acre-inch of needed and conserved water on a full stand of growing corn is worth up to 12 bushels of grain, depending upon the severity of the need and the available mineral nutrients.

MANAGING FOR SOIL PRODUCTIVITY

Crop Rotations

Various crops are rotated with corn so that the cropping system as a whole will maintain or improve soil productivity and soil structure. In the Corn Belt, corn generally fits well into rotations with such crops as small grains, soybeans, and sod crops. In most other places where corn is less extensively grown, small grains and sod crops also are well adapted. Deep-rooted legume crops, including alfalfa, sweetclover, and sericea lespedeza are particularly valuable in a rotation with corn. Their roots penetrate subsoils that do not have pan formations, and make use of moisture at lower levels. As these deep roots decompose they leave channels that improve water intake.

Climatic and other conditions influence the production of the various crops in a rotation. In the Southern States the growing of grass and mixed grass and legumes has increased rapidly during recent years. This has led to greater use of rotations involving grasses grown for relatively long periods with occasional corn on freshly plowed sod. The sod may have provided pasture crops or hay for

2 to 5 years, or even longer. Percentage of crop acres in corn is usually much smaller in the South than in the Corn Belt.

The kinds of livestock kept determine, to a considerable extent, the economic use that can be made of sod crops. Spring oats are usually grown in rotation with corn in the northwestern part of the Corn Belt. Three sample rotations will serve to illustrate varied farm programs in the large area where spring oats are grown.

A commonly used rotation that keeps 50 percent of the plowed acres in corn is: Corn, first year; corn, second year; oats, third year; and clover, fourth year. Second-year corn should receive a substantial application of manure, commercial fertilizer, or both.

The same percentage of corn is sometimes grown in a 2-year rotation that includes corn the first year, followed by oats and sweetclover. The sweetclover is turned under for green manure. Such a rotation is often used on farms inadequately supplied with livestock.

On large, adequately stocked farms, the following 8-year rotation with 25 percent of the plowed acres in corn is sometimes used:

First year—corn.
Second year—soybeans.
Third year—oats with sweetclover.
Fourth year—corn.
Fifth year—soybeans.
Sixth year—oats.
Seventh year—alfalfa.
Eighth year—alfalfa.

Alfalfa in rotations should be grown for at least 2 years.

Where winter wheat or other fall-planted small grains are grown, a 3-year rotation with one-third of the plowed acres in corn is popular. This consists of corn the first year, wheat the second year, and mixed hay the third year.

The rotations listed in the preceding paragraphs are suggestive of those that may be required on any particular farm. The best rotations are tailored to fit the soil requirements and all-round operations of each farm.

The erosion hazards of a particular farm must always be taken into account in choosing a rotation. A farm with gentle nonerosive slopes can carry a larger percentage of corn acres than one with steeper slopes or less stable soil.

Consideration is currently being given by certain farmers to the practicability of growing continuous corn for a period of 5 or more years, on fields of very gentle slope in the Corn Belt. The heavy applications of fertilizer used stimulate production of greater quantities of crop residues, including roots. These organic materials aid in the preservation of soil structure. Experience gained from growing corn in this manner is not yet sufficient to judge the long-term value of such a system. It offers promise, however, in limited areas, including certain irrigated farms.

Green Manures

The planting and plowing under of green-manure crops (fig. 4) as a means of improving soils is an important part of many corn-producing programs.

Green manures add organic matter to the soil and, if they are legumes, fix in the soil large amounts of nitrogen which they take from the air.

FIGURE 4.—Plowing under a green-manure crop is often an important step in a corn-producing program. The well-crowned furrows show that depth of the moldboards and speed of the tractor are correct and that the soil is moist but not wet. An excellent seedbed for corn is in prospect.

The amounts of nitrogen taken from the air and fixed in the soil by legumes vary widely with the kind of legume, the stand, and the fertility of the soil. Legumes grown as cover crops and turned under before reaching maturity (as in the South) normally fix less nitrogen than do sod-forming legumes that grow for longer periods during warm weather.

The average amounts of nitrogen fixed per acre by several kinds of legumes growing as cover crops are as follows: Austrian Winter peas, 50 pounds; velvetbeans, 65 pounds; crimson clover, 95 pounds; sweetclover, 120 pounds; and lupines, 150 pounds.

Legumes are also well supplied with organic phosphorus which is of great value to the corn crop.

The Corn Belt is sharply limited in the kinds of green-manure crops that can be grown because of temperature conditions. Sweetclover is one crop that makes a satisfactory growth after small grains have been harvested. The nitrogen-fixing power of sweetclover is high, and the percentage of nitrogen is high in the plant tissues. With normal rainfall, the growth of sweetclover above ground will range from 1½ to 3 tons per acre on a dry-weight basis. A substantial root system equal to about one-third of the aboveground weight will also contribute to the organic matter of the soil.

Sweetclover has one disadvantage. If it is grown frequently on the same tract of land, there may be an increase in insect populations and disease organisms.

In the South winter cover crops are essential following row plantings of any kind. In addition to adding organic matter and nitrogen to the soil, they retard surface erosion and prevent winter rainfall from leaching out the plant nutrients in the exposed soil. Growing conditions in the Southern States are favorable for a wide variety of

legumes suitable for use as green manures. Crimson clover, alone or with grains, is perhaps the most widely used as a green-manure crop. Austrian Winter peas, vetches, and various kinds of beans are also widely used.

Animal Manures

Animal manures vary widely in chemical composition, depending on the kinds of animals kept, the kinds of feed consumed, the quality of the litter or bedding used, and the methods of storage and handling.

Manure usually contains from 50 to 70 percent water as hauled to the field. In this condition one ton of manure ordinarily contains fertilizer constituents equivalent to that of 100 pounds of commercial fertilizer with a 10–5–10 ratio of NPK. The first number is the percentage of nitrogen (N) in the mixture; the second, the percentage of phosphoric oxide (P_2O_5) ; and the third, the percentage of potash (K_2O). The composition of wet manure, then, is equivalent to about 0.5 percent nitrogen, 0.25 percent phosphoric oxide, and 0.5 percent potash. Additional fertilizer values come from some of the secondary and minor elements in the manure, and especially from its organic matter.

In the Corn Belt manure is used most profitably when applied to the land just ahead of the corn crop in a rotation, and particularly before second-year corn. When manure is applied to small grain it may provide better germination of the oversown clover seed. Even then, the benefits from the manure will come largely through increased corn yields after the clover is turned under.

Applications of manure at rates up to 20 tons per acre may be very profitable, but few farmers have enough manure to cover their corn land at such a high rate. Commonly, manure is applied at the rates of 8 to 12 tons per acre.

On areas freshly seeded to sod-forming crops, rates of application of manure may be more nearly 4 to 6 tons per acre.

The residual effects of manure vary widely with soil type and prevailing climatic conditions.

Chemical Fertilizers

Even with good management, few soils that have been farmed continuously for a generation will grow corn crops of 80 or more bushels per acre without the addition of chemical nutrients. A corn crop of 100 bushels per acre usually removes from each acre of soil about 160 pounds of nitrogen, 50 pounds of phosphoric oxide, and 80 pounds of potash. Appreciable quantities of other plant nutrients, such as calcium, magnesium, and sulfur, are removed too, but only rarely is the remaining amount insufficient for high corn yields on well-limed land of the Corn Belt.

To continue to produce 100-bushel corn crops would seem to require only the immediate replacement of the depleted elements. The problem, however, is not that simple. Any cultivated soil is an active, constantly changing system. The nutrients may be leached away, removed by erosion, or they may change chemically to forms that are not available to plants or that become available slowly. In general, the supplies of nutrients, which may be large or small, are slowly given up to the growing plant.

Plant nutrients are usually most readily available in soil that is neither highly acid nor alkaline and that is well supplied with organic matter. Furthermore, a high proportion of the soil-released nutrients will be taken up by corn plants if good crop practices are followed throughout a rotation.

Exact recommendations for applying the three principal fertilizer constituents in a specific locality can best be made by State agricultural experiment stations or county agents. In general, if animal manures and crop residues are returned liberally during the rotation, the need for potash ordinarily may be met by only modest row applications at planting time. Potash depletion may be expected, however, if heavy legume crops, especially alfalfa or red clover, are removed from the land.

In the Corn Belt, where considerable quantities of farm manure are used for corn, 8 to 10 tons are often applied to a part of the corn land before the ground is plowed for planting. Frequently this is followed by row applications of fertilizer of 3–18–9 or 0–20–10 grade at rates of 250 to 300 pounds per acre. This practice usually supplies adequate quantities of phosphorus and potassium. In the Corn Belt, many farmers prefer to supply a part or all of the phosphorus needs by applications of raw rock phosphate at a rate of perhaps 1,000 pounds per acre once in 8 to 10 years.

In the Southeastern States, where animal manure is in scant supply, fertilizers of 1–1–1 ratio such as represented by an 8–8–8 grade are often used. Such grades are also frequently used elsewhere.

Nitrogen fertilizer requirements for corn vary widely in different parts of the United States. On dark soils from Nebraska through Pennsylvania and northward, supplemental nitrogen may be unnecessary if the corn follows a good plow-down crop of sweetclover or a legume meadow. However, recent experiments in Wisconsin and on irrigated soils in Washington have shown that it is profitable to apply additional nitrogen on already highly productive soil where stands are increased to as many as 18,000 plants per acre.

On light-colored northern soils, it is usually profitable to add chemical nitrogen in amounts up to 100 pounds per acre. This is especially true if manures or legumes are not used and if only cornstalks, straw, or nonlegume sods are plowed down.

In the area immediately south of the Corn Belt, the addition of chemical nitrogen becomes more important. Experiments in Missouri have shown that corn yields were profitably increased by adding nitrogen, even with adequate minerals in the soil and in the presence of good legume residues.

In the Cotton Belt, heavy nitrogen fertilization is a necessity for near-maximum corn yields regardless of soil type or cropping system. Moreover, the time of application becomes much more important than in the central Corn Belt. Applications both at planting time and after the crop is up and actively growing are necessary for best results.

In all parts of the country, corn gives a greater response to nitrogen with ample moisture than without. This has been shown in experiments on irrigated soils in Washington and Utah and unirrigated soils in Arkansas and North Carolina.

Anhydrous ammonia and other liquid forms of chemical nitrogen are now widely used for fertilizing corn. These compare favorably in cost and effectiveness with solid forms of nitrogen.

In making row applications for fertilizer, care should be taken to keep the bands 1½ to 2 inches to the side and an inch or so deeper than the seed. If closer, the fertilizer may delay germination and reduce stands. Potash and nitrogen are especially injurious when applied too heavily at an improper position with respect to seed. There is also more danger to the corn when the soil is dry than when it is moist.

Deficiencies in plant nutrients are shown in various ways by the corn plants during the growing season. The lower leaves show certain deficiency symptoms first. They should stay green until the crop is practically mature. Early dying along the leaf edges toward the tip indicates potassium deficiency. Purpling of the leaves of young corn plants, usually accompanied by slow growth, indicates phosphorus deficiency. When these symptoms appear, it is too late to remedy the deficiencies during the current year. Treatment for the next growing season is indicated. Yellowing and dying along the midrib in a widening band toward the leaf tip is typical of serious nitrogen deficiency. Nitrogen hunger in young plants is shown by an anemic yellow-green color of all leaves. The deficiency can be remedied during the current season by applications of nitrogen at this stage of growth.

Chemical tests aid in determining the quantities of different fertilizing constituents that should be added to a soil for the growing of a particular crop when climatic conditions are favorable. Such tests are usually relatively easy to make but difficult to interpret. Many of the State agricultural experiment stations and county agents provide a testing service. These tests, when interpreted on the basis of extensive local experience, provide adequate information regarding the lime needs in a crop rotation. Tests for available phosphoric oxide and potash are useful but leave much to be desired regarding their relation to economic additions of these two fertilizing constituents. Nitrogen tests are of much less value.

PREPARING THE SEEDBED

Certain phases of seedbed preparation may begin a year or more before the corn is planted. Installation of diversion ditches or terraces may be advisable on sloping land. Fields may need rearranging to make possible the planting of corn rows on the contour rather than up and down slopes. Recent work of the Soil Conservation Service has shown significantly higher yields and lower soil losses for contour surface planting in West Virginia and Ohio and for contour listing in western Iowa. If a field intended for corn slopes as much as 5 or 6 feet per 100 feet or if there is evidence of erosive action on even milder slopes, a need for stripcropping may exist. In some places, long slopes of only 2 percent may require contour planting or perhaps stripcropping.

If the soil is one that forms a hard crust after heavy rains, the cropping system may need adjustment so that corn will follow a soil-mellowing grass or legume sod rather than a tilth-depleting intertilled crop, such as corn, cotton, or soybeans. Liming, where needed, starts

off a chain of biological and physical activities that tend toward mellow workable soil.

A field is not suitable for efficient corn production unless a mellow seedbed can be prepared and kept in place.

Plowing

The objects of plowing land for corn are to cover trash and break up the soil so that a mellow seedbed can be prepared.

Plowing overwet soil often leaves large unmanageable clods, especially in soils of fine texture and low organic content. The soil is too wet for seedbed preparation when the furrows turn up shiny and fail to crumble during plowing or if a handful of upturned earth can be squeezed into a ball that sticks together.

Some clay soils will become mellow only if they are plowed in the fall. Certain injurious insects are partly controlled by fall plowing. Fall plowing, however, is generally not advisable on soils that are subject to winter erosion. Fall-plowed silt loams often become compact again during the winter and require replowing or extensive stirring in the spring.

Plowing usually is deep enough if furrows lie on edge at about a 45-degree angle and nearly all of the surface trash is covered. A furrow depth of one-half to three-fifths its width is about right to edge furrows in this manner. As an ideal, the plant residues should be evenly sandwiched between the furrow slices from the plowsole to the pit of the V between the furrow crowns. There is no point in trying to cover every bit of plant residue unless it is necessary to bury pests like borers in cornstalks. In that case stalks should first be thoroughly disked or shredded (fig. 5) and the furrow slice should be 6 inches or

FIGURE 5.—Shredding cornstalks before the residue is turned under is a useful practice, especially where it is necessary to bury pests like corn borers.

more in depth and completely turned over. There is no convincing evidence that plowing or other tillage deeper than needed to attain the objectives discussed above is beneficial for corn.

Final Preparation

Seedbeds for corn should be only fine, loose, and deep enough to provide good contact between the seed and moist soil. A slightly lumpy surface or one of small clods is superior to a fine powdery surface. In experiments in Ohio 66 to 75 percent runoff was recorded from 2.25 inches of rain falling on a fine smooth surface of erodible soil in 1 hour as compared to only 26 percent runoff where the surface was in small clods. Soil losses by erosion were 4 times greater from the fine soil.

In the drier areas final preparation of the seedbed may begin as much as 3 to 4 weeks before planting. The tools may be the disk and spike-tooth harrow, the one-way disk plow, the field cultivator, or the lister ridge buster. Newly germinated weeds can be killed by later tillage just before planting.

In the more humid areas toward the eastern part of the United States, plowing is often delayed by wet soil. Seedbed preparation then must follow soon after plowing. The disk and the spring-tooth harrow, followed by the spike-tooth harrow and sometimes by the cultipacker, are the commonly used implements.

The disk kills weeds, loosens and partly smooths the surface, but packs the lower plowed layer. The spring-tooth harrow loosens the surface, kills weeds, and has little compacting effect, but it may bring too much trash to the surface. The spike-tooth harrow smooths, kills small weeds, and has little compacting effect. The cultipacker crushes reasonably soft clods, compacts the upper part of the plowed layer, leaves the surface of a mellow soil in smooth little ridges, but kills few weeds.

The choice of the best combination of soil-fitting implements must be guided by local experience and knowledge of the soil in question.

Plowed soil is too often overworked, resulting in destruction of tilth by overpacking. The Michigan Agricultural Experiment Station has suitably prepared ground for corn planting with simple implements which are attached to and pulled behind a 2-bottom plow. The implements are just wide enough to work two furrow slices with a few inches of overlap. One of them is a narrow cultimulcher consisting of two sections of cultipacker disks, having two rows of spring teeth between (fig. 6).

Another implement of the same width and used in the same way and for the same purpose is an assembly of rotary-hoe wheels in two rows.

The use of these simple tools offers the advantage of reducing or even eliminating the great compacting effect of tractor wheels on plowed ground during seedbed preparation.

Mulch Tillage and Manure Mulching

Mulch tillage, also called trash mulching, stubble mulching, and subsurface tillage, leaves most of the surface residues aboveground as the soil is being prepared for planting. Special furrow openers have been devised for planting through the residues.

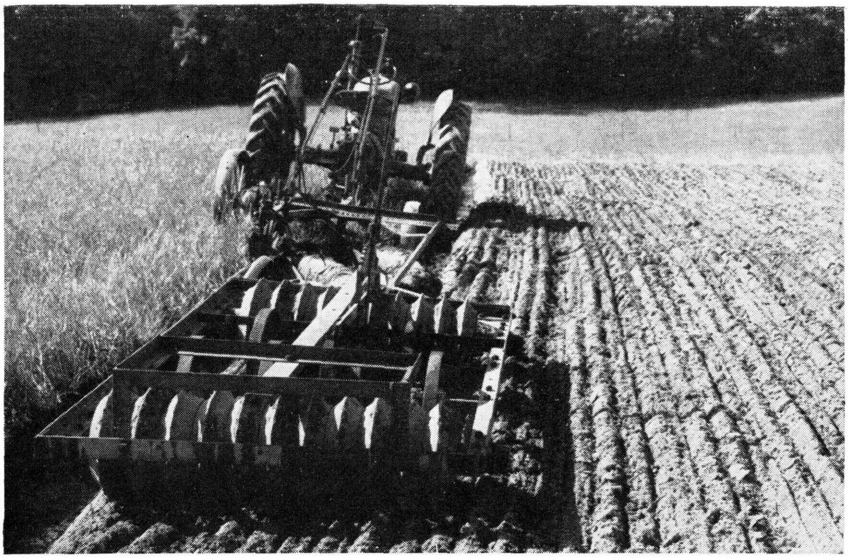

FIGURE 6.—Plowing and "fitting" of the soil can sometimes be done in one operation with implements like this cultimulcher.

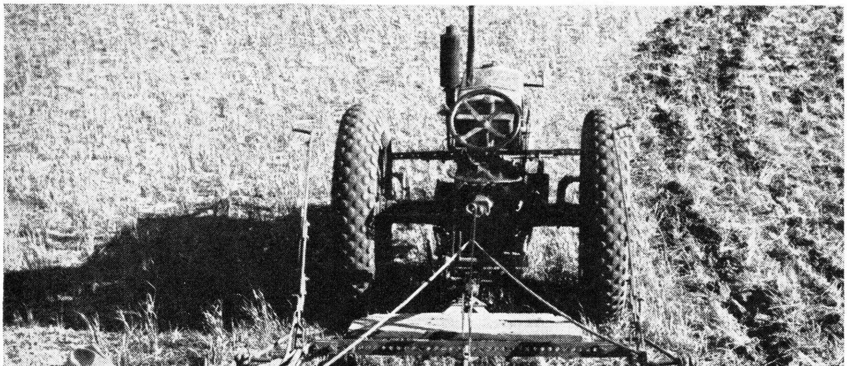

FIGURE 7.—Mulch tillage with implements that undercut the soil helps to conserve moisture and prevent erosion and runoff in the drier areas where corn is grown.

Mulch tillage may be done with a one-way disk plow—common in the Great Plains area—often followed by a rod weeder. Also heavy V-shaped blades, or the small sweeps of heavy field cultivators, may be drawn a few inches under the soil surface, lifting and loosening the soil but not turning it (fig. 7).

The use of mulch tillage for corn appears to be limited to dry regions, porous soil, and sloping land where erosion is important. It reduces runoff and erosion by protecting the soil surface from puddling by rainfall and from exposure to wind.

In Ohio, erosion losses in plowed cornland were compared with similar land that had been mulch tilled. The plowed land lost an average of 16 tons of soil per acre, compared with only 0.2 ton for the mulch-tilled land. Rainfall averaged 15 inches for the two May-to-September periods studied, and the slope was 15 percent.

Unfortunately, planting and cultivation of corn through the surface residues are usually difficult. Mulch tillage, as developed up to now, has failed in the Corn Belt to produce corn yields equal to yields on plowed land.

An alternative to mulch tillage for some livestock and grain farmers is manure mulching. Six to eight tons of manure per acre are applied with a manure spreader to the corn after it is up and after early weed growth has been controlled. In experiments in Ohio, manure used this way has increased immediately succeeding corn yields as much as when plowed down before planting. More important, the practice has conserved an average of 2 inches of rainfall, which otherwise would have been lost, and it has reduced soil-erosion losses from an average of 15 tons per acre to less than 1 ton on short slopes of erodible soil. Disadvantages are that the soil is left exposed to erosion for a short but hazardous period, the manure must be applied at a busy time, and the cultivations through the mulch are sometimes difficult.

PLANTING

Time of Planting

Corn generally is planted 10 days to 2 weeks after the average date of the last killing frost in any particular locality (fig. 8). Planting before that period is considered to be early and that afterward is considered to be late. A delay of 2 days in planting will normally delay silking and maturity about 1 day on the average.

Light soils, good drainage, and good crumb structure favor early planting. Early planting may be advantageous when the soil is dry enough for good coverage, if weather forecasts indicate that temperatures will remain above 60° F., and if there are no probable local hazards such as floods or infestations of cutworms, budworms, or corn borers. Over a 20-year period at the Ohio Agricultural Experiment Station, best yields were obtained by planting between May 7 and 12, which is early for the area. Delayed planting of 1, 2, and 3 weeks gave yield reductions of 2, 7, and 14 bushels per acre, respectively.

Planting Rates

The right stand is more important than a strictly uniform stand or a particular method of planting. The most productive stands

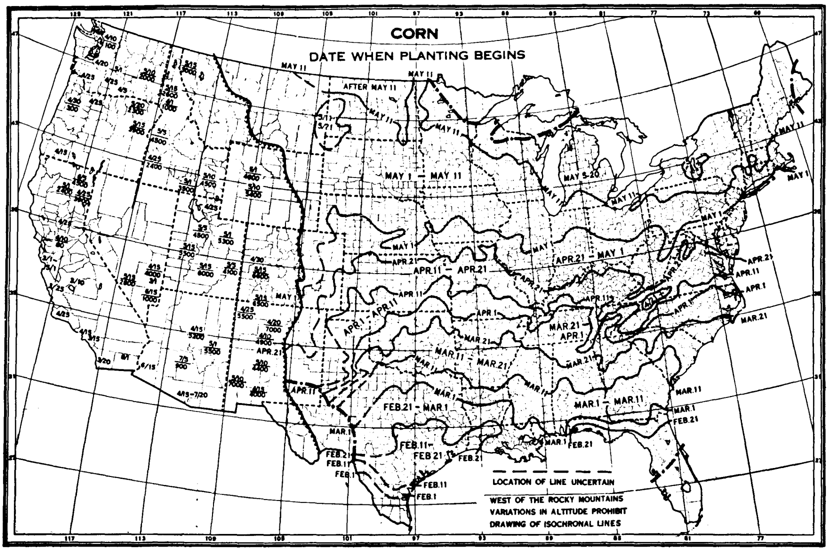

FIGURE 8.—Average dates when corn planting begins in the United States.

range roughly from 6,000 to 20,000 plants per acre. They should be heavier for earlier and smaller hybrids, shorter seasons, and higher moisture supply and soil productivity. Thick stands result in easier weed control, but more lodging and smaller ears.

Stands that produce air-dry ears weighing about one-half pound each will make best use of the available soil fertility (fig. 9). In the eastern Corn Belt this normally requires the planting of three viable seeds to each 40 inches of row length, in rows 40 inches apart, where expected yields are 60 bushels of grain to the acre or less. One viable seed should be added to each 40 inches of row length for each 20 or 25 bushels of expected yield over 60. The top limit in the Corn Belt should be about 7 seeds in 40 inches of row regardless of soil productivity.

The most favorable planting rates are lower south and west of the eastern Corn Belt and higher to the north and east. The best planting rate in eastern Texas is between one-half and two-thirds that in Pennsylvania, but in either area a half-pound ear weight will indicate that the planting rate was about right for the growing conditions.

The practical upper limit for stands with corn hybrids now available is not definitely established. But it appears to be not far from 20,000 plants per acre—probably more for the northern tier of States and fewer for the southern tier. Twenty thousand plants per acre will be attained by planting seeds 6 inches apart in rows 40 inches apart, if 85 percent of the seeds make mature plants.

In a 20-year experiment with open-pollinated corn, in Ohio, the maximum grain yields were produced at 14,000 plants per acre. In the same experiment maximum silage yields were higher almost in proportion to stand up to 18,000 plants per acre. The most productive stand for silage is near the upper limit set by danger of lodging and of early depletion of soil moisture and nutrients. It will, therefore, be much heavier than for grain on moderately productive soil,

FIGURE 9.—The half-pound ears of corn on the left indicate a good balance of stand with soil productivity. The ears on the right, with average weights of 0.8 pound, indicate that the stand could have been increased profitably by 5,000 to 6,000 plants per acre.

and about the same as for grain on the most fertile and well-watered soils.

The essential mechanism of modern corn planters is a cylindrical hopper with a revolving plate at the bottom. The seed passes through cells (holes or edge notches) in the plate. The planting rate is determined by the size and number of the cells and the revolving speed of the plate. Manufacturers of corn planters have provided good assortments of plates and simple means of adjusting their revolving speed. Any well-graded lot of seed corn can be planted at a desired rate within reasonable limits. The correct plate selection is the key to controlled planting rate. Plates designed to select one seed at a time require well-graded seed. Those having large cells that pass more than one seed are less exacting in the requirements for uniform seed grading.

Planting Methods

Surface-planted corn may be in checkrows (rows in two directions at right angles), drilled one seed in a place, or hill dropped (fig. 10). Checkrowing requires skilled operation and more time than drilling or hill dropping, but it permits cross cultivation which often is advantageous in controlling weeds. In hill dropping, two or more seeds are dropped together without regard to cross rowing.

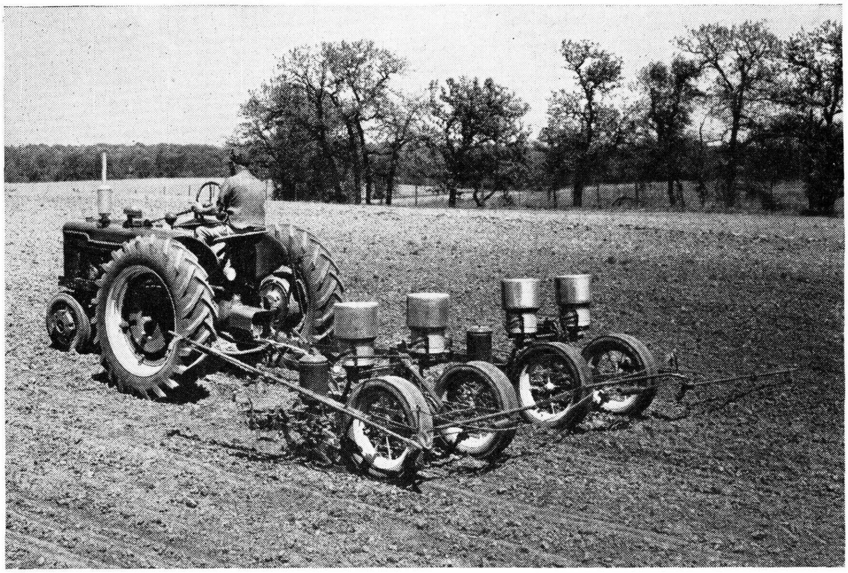

FIGURE 10.—This four-row corn planter is equipped for checkrowing or hill dropping. The fertilizer units mounted above and behind the seed boxes are used for applying dry fertilizer in the row. The slightly lumpy soil surface shown is preferable to one that is very fine and overpacked.

These three kinds of planting can be expected to yield practically alike if weeds are controlled equally well and if stands in terms of plants per acre are the same. Experiments in Indiana and Ohio, however, have shown that there is more lodging in drilled corn than in hilled corn and that drilled corn suckers (tillers) more. The suckers have had little or no effect on yield in recent experiments in Nebraska and Ohio.

Tests at the Nebraska Agricultural Experiment Station have shown no significant difference between hilled and drilled corn in efficiency of mechanical harvest. In drilled corn at close, medium, and wide spacings of plants in the row, the picker harvested 88.3, 87.0, and 86.7 percent of the total crop, respectively. The corresponding percentages harvested in hilled corn were 85.3, 88.2, and 87.2.

Row spacing has become standardized at about 38 to 42 inches in the Central, Northern, and Eastern States along with the standardization of other row-crop equipment. There is usually no advantage in spacing rows closer than 40 inches, except on soils of very low productivity. Tests in Ohio have shown that row spaces can be widened to 6 feet to permit interplanting of winter grain, meadow, or plowdown crops with a yield reduction of not more than 10 to 15 percent. For the practice to be successful, soil productivity should be high and the normal planting rate per acre should be maintained. On land capable of producing 70 to 75 bushels of corn to the acre at normal row spacing, there is an expected drop of 4 to 5 bushels at 60-inch spacing and 9 bushels at 70-inch spacing. Advantages to an interplanted crop may more than offset these lower corn yields (fig. 11).

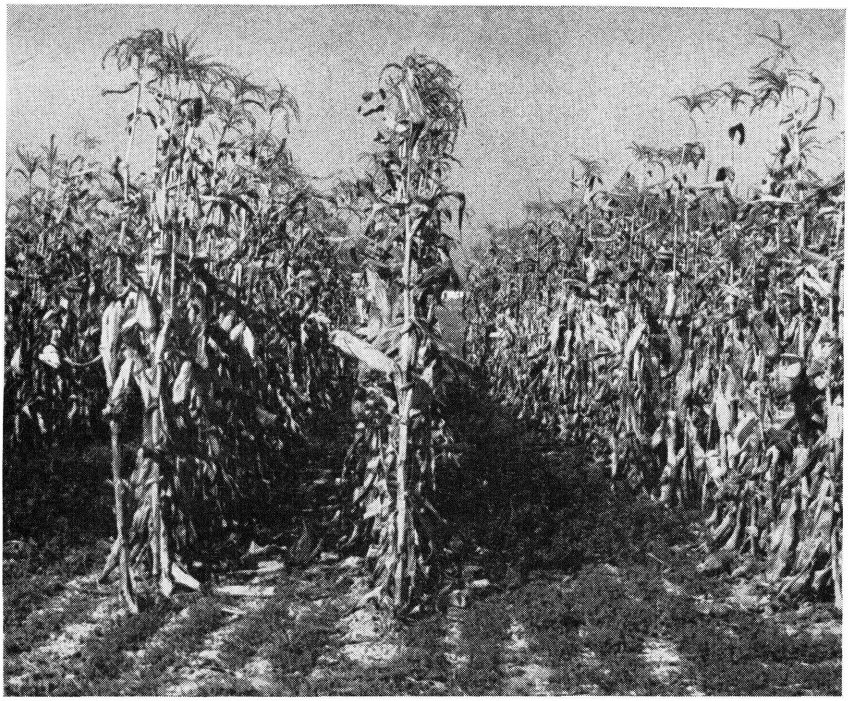

FIGURE 11.—Sweetclover has been interplanted with corn in this field. Seeding was done with a standard grain drill when the corn was 12 to 18 inches high. Corn rows are alternately 40 and 72 inches apart. Corn yields are 5 to 10 bushels per acre lower than with standard planting and clean culture, but corn can be grown more often in the rotation.

Planting Depth

Seed corn should be placed in close contact with warm, moist soil and with enough covering for reasonable protection against birds, rodents, and surface drying. Quick germination and quick seedling emergence mean less trouble from soilborne insect and disease pests or from crusted soil. Because soil warms and dries from the top down, the preferred planting depth increases as the planting season advances. One inch under settled soil is shallow planting; 3 inches is deep. The depth of the root system is not increased by planting depths greater than 1 inch.

Preparation and Planting in One Operation

Systems that combine soil preparation and seed planting may save time and labor. They also permit planting in short periods of good weather, which often is highly important. A familiar experience of corn farmers is a period of bad weather just after seedbed preparation. Days of growing season are then lost, and expensive reworking of fields is necessary.

Lister planting is the nearest practical approach to a one-operation system. The seed is planted while the soil is being stirred. Lister planting often is preceded by blank listing of the soil or by disking,

one-waying, or plowing. The lister is essentially a plow with a double moldboard that opens a furrow and throws the soil to each side. A planting attachment drills the seed into the furrow. The ridges of loose soil cover trash and small weeds between rows. Special disk cultivators throw the soil out of the furrow during early cultivation, and in the final cultivation they level the ridges and move the soil into the furrows where it buries the weeds after the corn plants are larger.

Listing is not favored in northern areas having roughly 30 inches or more of annual rainfall because of the slow germination and seedling growth in the cold soil of the furrow bottoms. In drier areas listing often is superior to surface planting in dry seasons. Listing is not a suitable planting method in heavy legume-grass sods because it does not kill their growth. It is not practiced widely in the better parts of the Corn Belt.

Machines that prepare a seedbed, fertilize, and surface plant in one operation are now being introduced. Experience with these devices, however, is still too limited to permit definite recommendations. The attachment of corn planters behind tillage implements is an uncommon practice.

CULTIVATING

The most important function of cultivation is to kill weeds. Weeds are easiest to control by mechanical means when they are very small; if possible, even before they can be seen aboveground. The most economical and efficient implements for early cultivation of mellow, easily worked soils are the spike-tooth harrow, the spring-tooth weeder, and the rotary hoe. They are wide, light, can be pulled rapidly, and have little compacting effect. Since they work near the surface they do not bring the more deeply buried weed seed up where it can germinate. Many annual weeds are destroyed when the corn is cross-cultivated by these implements before it has emerged and again between emergence and the 5-leaf stage.

These tools have little effect on well-established perennial weeds, or on annuals such as the cocklebur that can germinate well below the soil surface. The rotary hoe is especially useful in breaking a crust on the soil surface.

The shovel cultivator is still the most effective implement for early cultivation of soils that are difficult to work, and for corn larger than the 5-leaf stage. Slow speeds are advisable for early cultivating and shields, or preferably rotary-hoe wheels, should be used to protect the small corn plants from being buried (fig. 12). The best time for the later cultivations is soon after the soil surface has dried, following a rain. There usually is no advantage in cultivating corn after it is 24 to 30 inches tall if weeds have been kept under control by earlier cultivation and if stands are adequate to provide uniform shade.

Cultivate just deep enough for weed control. Gouging down 4 inches is very damaging to corn roots after the plants are past the seedling stage. Furthermore, there is no benefit to the plants from a ridge of soil higher than necessary to cover weeds.

The "duck foot" cultivator sweep which runs nearly flat under the surface is the most generally useful type of shovel. Such sweeps cannot be kept in hard soil, however, except with heavy tractor culti-

FIGURE 12.—The rotary-hoe wheels on this two-row corn cultivator protect corn plants from being buried during early cultivations. The most effective time to kill weeds by cultivating is just before or soon after they break through the surface.

vators. Pairs of disks, one on each side and next to the corn row (disk hillers) in combination with sweeps are highly effective for late cultivations, for controlling vine weeds, and for cultivating trashy ground.

Insuring adequate water intake and aeration are sometimes important functions of corn cultivation. Loose, unpulverized soil takes in water more effectively than does a dust mulch and conserves it just as well. Evaporation from either type of soil surface is slight as compared to losses through the corn leaves (transpiration losses). Cultivation where few weeds are present may be beneficial to loosen or to break the crust on fine-textured, poorly granulated soils that have become compacted or sealed at the surface after rain. The breaking up of such soils permits better water intake and accelerated nitrification because of better aeration. The effects of wind erosion on light (sandy) soils often can be reduced by breaking into clods any crusts that may form.

Chemical Weed Control

Chemical weed control can greatly aid farmers in reducing corn losses due to weed competition. Formulations of 2,4-D applied as sprays give the best field control of weeds in corn. They can be used before the corn emerges, after it has emerged, and during the layby period. These are known, respectively, as preemergence, postemergence, and directed postemergence treatments.

Combinations of preemergence and postemergence treatments are often used to achieve long-term control. In such cases, the pre-

emergence sprays, which are applied at heavier rates, control annual grasses and broad-leaved weeds for periods of 5 to 7 weeks; the postemergence sprays control the broad-leaved weeds that germinate after the effects of the first treatment have dissipated.

Spraying with 2,4-D should not be expected to replace cultivation entirely, for weeds that are not controlled by the chemical will rapidly infest the sprayed area. Also recent experiments have shown that some soil types give higher yields when cultivated even though no weeds are present.

Preemergence sprays of 2,4-D are usually applied at rates of 1 to 2 pounds of acid equivalent per acre. At this rate they are effective against annual grasses and some broad-leaved weeds that are not controlled with postemergence sprays. Preemergence spraying can be done at any time between germination of the seed and the unfolding of the leaves as the plants emerge from the soil. The esters of 2,4-D rather than the amine salt formulations are recommended for preemergence spraying.

Preemergence treatments are effective in most areas and on most soil types. They are especially useful on river bottom soils having heavy weed infestations. Preemergence sprays should not, however, be used on sandy loams or lighter soils. There is danger of too-deep penetration and injury of the germinating corn on such soils. Soils high in organic matter require higher rates of application than those low in organic matter. Dry weather after preemergence treatments lessens their effectiveness; an excess of rain increases their effectiveness.

Postemergence sprays (overall sprays) are applied at rates of ¼ to ½ pound of 2,4-D per acre. Ester formulations should be used at the lower rate and amine salt formulations at the higher rate. Spraying after emergence should be done usually when the corn is 6 to 10 inches tall to obtain the most effective control of weeds. The spray must be applied to the tops of the weeds for best kills. As the corn grows taller the chances of injury from overall sprays increase. Brittleness and some bending may be expected after treatment of corn that is several inches high. Cultivation should therefore be delayed for 5 to 10 days after spraying. Corn hybrids vary in their degree of susceptibility to 2,4-D, but the differences are not usually noticeable at rates below ½ pound per acre.

Previously weed-free corn may become heavily infested with weeds after the crop is laid by. Cultivation may be ineffective against weeds, especially during rainy periods. Mechanical harvesting is more difficult in weedy fields and heavy losses of grain may result. Directed spraying with drop nozzles can be done at this time to control the weeds. Applications of 2,4-D at rates of 1 to 2 pounds per acre are recommended. The nozzles should be arranged so that ½ pound per acre is applied on the bases of the cornstalks and on weeds in the row while 1½ pounds per acre is applied as a ground spray between the rows. This application should be made immediately after the last cultivation.

Chemical control of weeds in corn requires a thorough knowledge of spraying procedures. Equipment should be carefully adjusted and in good operating condition. Extreme care is necessary in calibrating nozzles to deliver the proper size of spray droplet, adjusting nozzle heights, and maintaining a tractor speed that delivers the spray at correct rates per acre. Precautions against damaging adjacent crops through drift of spray should be exercised.

FIELD INSECTS

Several hundred species of insects feed on the roots, stalks, leaves, or seeds of corn. About 25 of these are especially troublesome; several are shown in figure 13.

An important factor in reducing insect damages to corn is the choice of well-adapted hybrids. In general, a corn plant has a better chance of escaping with little or no injury if it is adapted to its environment, well fertilized, and thus capable of making vigorous growth. The European corn borer, however, concentrates on the

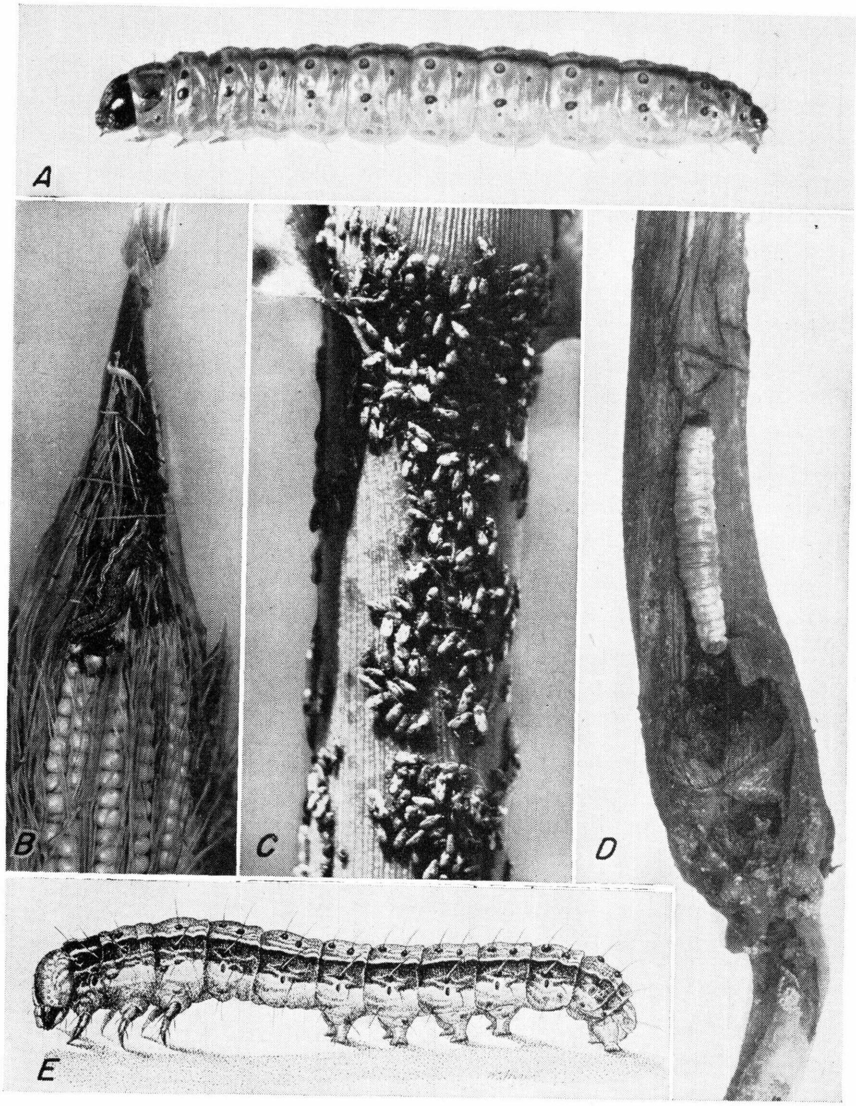

FIGURE 13.—Important corn-infesting insects: *A*, European corn borer, *B*, corn earworm; *C*, chinch bugs; *D*, corn rootworm; *E*, fall armyworm.

better fields and the better plants within a field. Corn breeders have countered by developing hybrids with relatively high resistance or tolerance, or both, to the borer. Resistant hybrids, where available, will do much to reduce corn borer losses.

Good methods of handling soil and seed also play an important part in controlling insects. If the seed germinates quickly and the seedlings grow fast, there is less danger of injury by seed-corn maggots, seed-corn beetles, wireworms, cutworms, webworms, flea beetles, or thrips. In an Ohio experiment white grubs averaging 8 to 14 per hill reduced unfertilized corn yields to 16 bushels per acre. Similarly infested plots receiving 8 tons of manure plowed down and 100 pounds of 3–12–12 fertilizer in the row yielded 73 bushels per acre.

Crop rotation tends to suppress certain soil-inhabiting insects like rootworms and root aphids that prey on corn. On the other hand, wireworms, cutworms, sod webworms, and white grubs thrive in grass sods. In such cases delayed and thicker planting to allow for some losses is usually better in the long run than giving up otherwise beneficial rotations.

A number of powerful insecticides have been introduced in recent years. They are variously used—in poisoned baits, sprayed or dusted on plants (fig. 14) or seeds, mixed with the soil, or even applied with row fertilizers. For best results they should be used as directed by State agricultural experiment stations, county agents, or the United States Department of Agriculture.

FIGURE 14.—A general-purpose sprayer being used for control of the corn borer. This type of sprayer may also be used to apply 2,4–D for weed control in corn.

DISEASES

The principal diseases of corn are smut and various rots, rusts, blights, and wilts (fig. 15). They are caused either by fungus or bacterial infections. The use of resistant hybrids is the best means of controlling most of these diseases. Another important factor in controlling some diseases is a well-managed soil in which fertility is

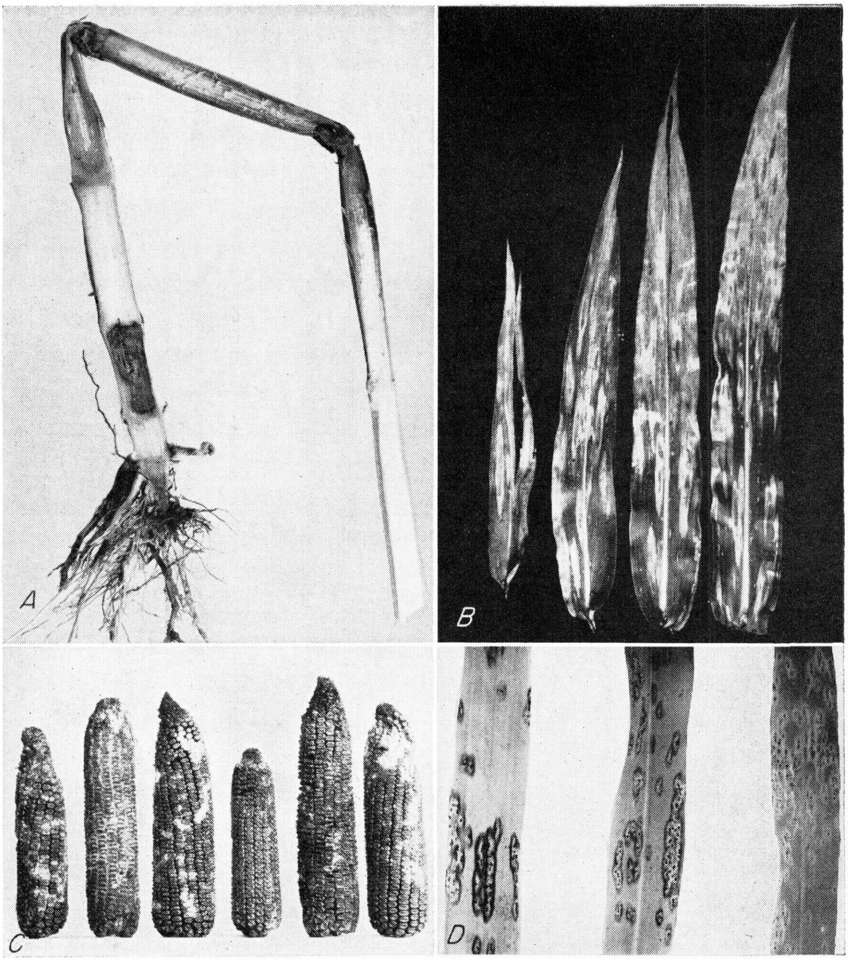

FIGURE 15.—Symptoms of important corn diseases: *A*, Stalk rot; *B*, helminthosporium blight; *C*, ear rot; *D*, leaf rust.

properly balanced. This requires the use of recommended rotations, maintenance of adequate amounts of organic matter in the soil, proper drainage, and fertilizers and lime when they are needed.

Seedling blights attack corn seedlings as they emerge from the soil. They are best controlled by (1) planting mature, uninjured, uninfected seed, (2) providing soil conditions that favor quick germination and rapid seedling growth, and (3) seed treatment with an effective fungicide.

Smut, a common disease of corn, is caused by a fungus and is characterized by irregularly shaped galls that may appear at any stage of growth on the stalks, ears, or tassels. Wounds from hail or injuries received during the later cultivations are likely spots for infections. Large galls on or above the ear reduce grain yields sharply. Resistant hybrids should be used where smut causes appreciable losses. Seed treatment is not effective.

Stalk rots usually, but not always, gain entrance beneath the soil and invade the stalks upward. Their severity depends on the earliness of infection and the speed of invasion. In general, early-ripening hybrids are more subject to stalk rot than full-season hybrids. Infected plants appear to be frosted or to have matured early. Brownish discolorations, which may easily be pressed in, may appear on the lower part of the stalk. When these symptoms appear before the seeds are hard, there will be losses in the quantity and quality of grain. Also there probably will be broken stalks. Well-nourished, resistant hybrids have the best chance of escaping stalk-rot troubles.

Corn is subject to a number of ear rots and kernel disorders. Contributing factors are poor husk cover, deep soft-starch grain, growth cracks in kernels, and weather conditions that delay drying of ears in the field. Control measures that can be applied on a field scale have not yet been developed, but certain hybrids are more resistant than others. Those with established records for producing sound grain should be given preference.

Epidemics of leaf blight diseases often cause losses in yield in the warmer and more humid corn-growing regions. The causal organisms may be bacteria brought in by flea beetles or fungi brought in by wind. Small spots or streaks appear at first mainly on the older leaves. The spots enlarge until entire leaves are killed. Severe losses in yield may be expected when many leaves are heavily blighted within about 2 weeks after silking time. Losses in yield are usually small if only a few blight spots occur during the month after silking. The upper and most active leaves are generally the last to be affected. Avoid susceptible hybrids where these leaf diseases occur—roughly south and east of central Indiana.

Corn rust is similar in appearance to the rusts of small grain. This leaf disease is now rated as of minor importance, but it is well to avoid hybrids of known susceptibility.

HARVESTING THE CROP

Corn is harvested for grain, silage, or fodder, and occasionally is cut and fed green.

Corn silage makes the most complete use of the crop. An acre of ensiled corn has about one-third more feeding value for beef cattle than an acre harvested for grain. Corn for silage is cut early enough to seed the land to winter wheat. When harvested and shocked the crop may be used as fodder or the ears can be snapped or husked. Cured corn stover (stalks with the ears removed) may be fed, but its feeding value is lower than when the corn is ensiled.

A sizable acreage of corn, particularly in the Corn Belt, is harvested by hogs. Two to five acres are enclosed with an electric fence and 40 to 60 hogs of perhaps 125 pounds in weight are allowed to feed on the crop. The fence is then shifted to an ungrazed portion of the field.

Grain

Tests in Iowa and Nebraska show that the sooner corn is picked after it is ripe, the lower the shelling loss. On the other hand, corn picked too early is too damp for safe storage, unless mechanical ventilation is available.

Harvesting of corn for grain is now largely mechanized in the Corn Belt and in other areas where corn is produced primarily for grain. About two-thirds of the corn harvested for grain in the entire United States was gathered by machinery in 1952, and in the important corn-producing State of Iowa about 97 percent was harvested with corn pickers. Immense savings of time and labor are possible when corn pickers are used. A man with a 2-row picker can gather the ears from an acre of corn and deliver the ears to a wagon in from 40 to 45 minutes. It usually takes one man about a day to husk an acre from standing stalks by hand and still longer to husk it from the shock.

Several types of corn-picking machinery now are available. The most common are the 1-row type, which may be tractor-drawn or semimounted, and the 2-row type, which may be tractor-mounted or self-propelled (fig. 16). The farmer with a large acreage in corn and the custom operator may prefer the self-propelled 2-row corn picker, of which there are several makes on the market. The picker-husker snaps the corn from the standing stalks, removes a considerable part of the husks, and delivers the ears to a wagon pulled behind or to one side of the picker or into a truck. Some machines snap off the ears, but do not husk them.

A multiple-purpose machine—the picker-sheller—is now being introduced. It picks, husks, shells, and delivers the corn into hoppers or trailing vehicles all in one operation. This machine will probably come into more widespread use, especially where harvesting is done on a large scale, because it makes possible a further saving of labor, time from harvest to market, and storage space. Such machines,

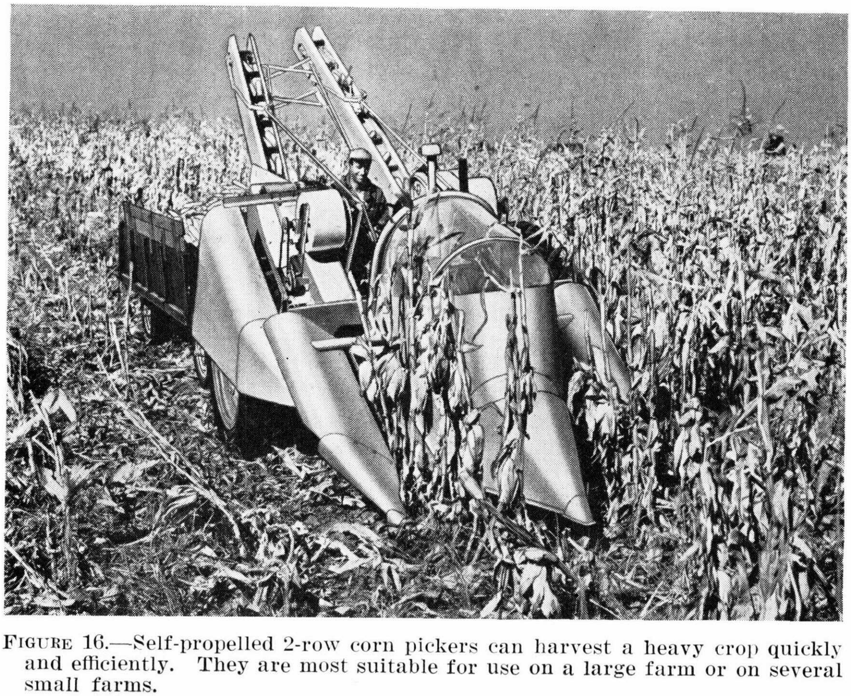

FIGURE 16.—Self-propelled 2-row corn pickers can harvest a heavy crop quickly and efficiently. They are most suitable for use on a large farm or on several small farms.

however, are relatively expensive and the corn as harvested usually requires mechanical drying.

Recent studies at the Pennsylvania State University have suggested that it would take 36 acres annual use to justify the purchase of a 1-row picker, or 50 acres annual use for a 2-row picker, taking into consideration such factors as depreciation, housing, taxes, insurance, and interest. The picker cost per acre can be reduced by more than half, however, if these minimum acreages are tripled. Common arrangements with neighbors include custom operation, exchange of different power machines, exchange of labor for machine work, and joint ownership.

Custom rates for picking corn vary, but the common rate in Minnesota in 1953 of $4.50 an acre is a fairly typical charge for a corn picker, operator, and tractor fuel.

The average price for corn as received by Minnesota farmers in 1953 was $1.35 a bushel. The custom price for picking, therefore, averaged a little less than the value of 3 bushels of corn. The most common rate for custom picking in Ohio in the same year was $5 per acre. Ohio farmers received an average of $1.80 per bushel for their corn. About 2¾ bushels were therefore required to pay for custom harvest on an acre.

Expert picker adjustment, timeliness of harvest, and moderate speed often will save the farmer far more than the fee for custom harvest. In Nebraska experiments the losses by shellage were less than 2 percent when the corn was mechanically harvested at a kernel moisture content of 22 percent. The loss by shellage ranged from 2 to 6 percent when the kernel moisture content was reduced to 15 to 17 percent, and the loss was 9 to 13 percent when the crop had stood in the field until the kernel moisture was down to 14 to 15 percent. Most of the shellage loss was at the snapping rolls.

The Illinois Agricultural Experiment Station checked 24 machines in mechanical corn picking contests in 1950. The losses in dropped corn for the 24 machines ranged from 5.5 to 25 bushels an acre in a cornfield that averaged 80 bushels per acre. The primary consideration in harvest cost, then, is not whether the acre fee is equivalent to 2, 3, or even 4 bushels of corn, but how well the job is done.

For maximum efficiency of operation, the row spacing of the 2-row picker should coincide with the width of rows as planted. Corn pickers now on the market usually have a fixed distance between the centers of the snapping units of 38, 39, 40, or 41 inches. These machines can handle variations in row widths of as much as 4 to 8 inches, but at reduced efficiency. For best harvesting results with 2-row pickers, 2-row or 4-row planters should be used that have about the same row width as the picker.

A 2-plow tractor usually will handle a 1-row picker, or even a lightweight 2-row picker where the ground is level and dry and the crop is light. A 3-plow or larger tractor will be required for a heavy crop. Tractor-drawn models can generally be adapted to fit nearly any make of tractor with standard power takeoff, but tractor-mounted types must be selected to fit a particular make and model of tractor.

***Caution:* Always stop the picker when cleaning the snapping or husking rolls or making any other adjustments.**

The corn picker is one of the most dangerous farm machines. It can cause the loss of hands, arms, and even lives. Such accidents are

needless. Reverse gear attachments now manufactured, which fit many types of corn pickers, enable the operator to clear snapping rolls and gathering chains by reversing their action from the driver's seat. The increased safety afforded by these attachments makes their purchase and installation well worth while.

Silage

Corn is at the best stage for harvest as silage when the husks are beginning to brown, the leaves are still green, and the grain has a glazed appearance.

Silage making formerly required much hand labor whether the corn was cut by hand or with a corn binder. The field silage cutter and mechanical dumping or unloading devices have eliminated most of the hand work in silo filling.

Some forage harvesters are provided with attachments for gathering row crops like corn. A 2- or 3-plow tractor is required where the field silage cutter or forage harvester implement mechanism is driven by power takeoff. Machines with auxiliary engines are more expensive than those driven by power takeoff, but they require less tractor power and they maintain the speed of the cutting mechanism when the tractor is forced to slow down.

Studies by the Pennsylvania Agricultural Experiment Station indicate that it would take about 50 acres annual use of a forage harvester or field silage cutter with power takeoff to justify its purchase. An even greater acreage would be required to justify the purchase of a self-powered forage harvester.

FARM STORAGE[1]

Corn grain generally contains from 15 to 25 percent or more of moisture in the kernels when picked. That is too high for safe storage in a tight bin. Provision, therefore, must be made for further drying after harvest.

Crib Storage

In the North Central States the common practice has been to place the husked corn in slatted-wall cribs where it dries by natural air circulation (fig. 17). Some loss of grain is caused each year by rats and mice in this region, but insect infestations are not usually heavy and crib storage has therefore been reasonably successful. In the Southern States, where insects attack stored grain seriously, crib storage is successful only for short periods.

A crib should be located where it will be exposed to drying winds and will be away from fire hazards. A good crib stands on a strong foundation, has a sound, tight floor and roof, has well-ventilated walls sturdy enough to resist the heavy outward pressures that develop as the ears settle, and is ratproof.

In the central Corn Belt a kernel moisture content of 20.5 percent at the beginning of storage is the desirable top limit for crib storage

[1] For detailed information on storage of corn see U. S. Department of Agriculture Farmers' Bulletin 2010, Storage of Ear Corn on the Farm; Farmers' Bulletin 2009, Storage of Small Grains and Shelled Corn on the Farm; and Farmers' Bulletin 1976, Handling and Storing Soft Corn on the Farm.

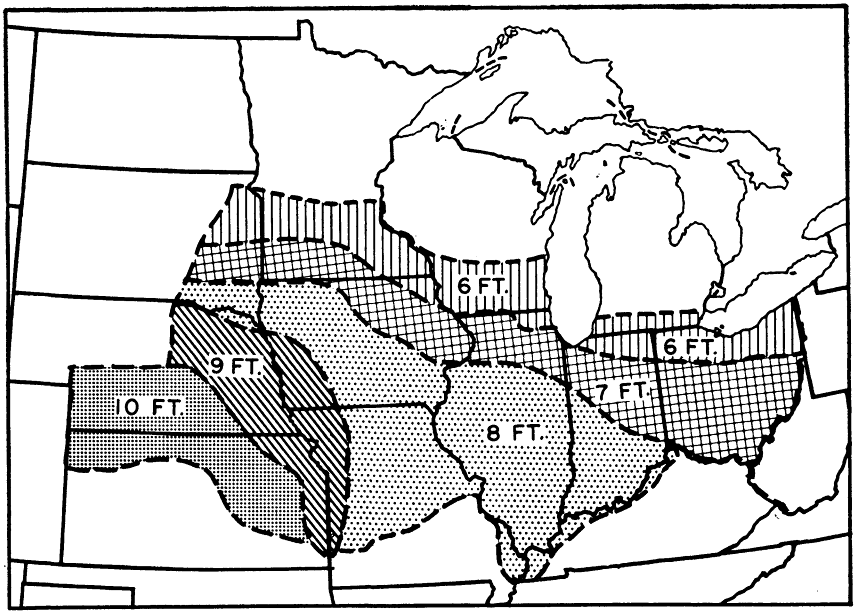

FIGURE 17.—Crib widths vary, depending on temperature and moisture conditions in different parts of the country. Maximum recommended widths for cribs in the Corn Belt are shown above.

of ear corn without mechanical ventilation. At this moisture content the crib should not be wider than 8 feet. The diameter of round cribs should not be greater than one and one-half times the widths of ordinary cribs. If the dimensions are larger than those indicated, a system of internal horizontal ducts should be provided to supply additional ventilation.

The best ear-corn storage requires clean harvesting and careful screening and spreading while the ears are going into the crib. Shelled corn, chaff, husks, and silks mixed in with ears retard air movement and consequent drying. Accumulations of trash are also focal points where spoilage may begin and spread outward to cause severe losses of grain.

Mechanical Drying

Several types of crib driers and other types of equipment for drying corn on the farm have been developed. These driers, which reduce the moisture content in much less time than by natural drying, are especially useful where adverse weather has delayed the drying of the corn in the field. In the Southern States, mechanical drying is an important means of getting the corn into tight storage quickly so that it can be fumigated to destroy insect infestations.

Corn is dried mechanically by forcing air through cribs or bins that have been adapted or designed for that purpose. Equipment now in use permits the drying of either shelled or ear corn. Some driers employ unheated air and others use air heated by furnaces burning coal, fuel oils, natural gas, or bottled gas. Systems utilizing unheated air are cheaper to install and operate and are relatively free

from fire hazard, but are slower than drying with heated air and can be operated only in dry weather.

With heated air it is possible to dry ear corn having a kernel moisture content of 35 percent or more. Corn with moistures up to 28 percent has been shelled with little evidence of crushing, and then dried.

Mechanical drying of corn on the farm usually is profitable when appreciable damage would follow natural drying. The methods and equipment for drying shelled and ear corn and factors influencing the feasibility of mechanical drying are discussed in leaflets available from the U. S. Department of Agriculture.

Controlling Insects in Stored Corn

From Virginia, Kentucky, and Missouri southward, farmers must carry on a continual fight against the rice weevil, the granary weevil, the grain moths, and other insects that attack stored corn. The means for combating such pests are increasing. The use of hybrids with long, tight husks that make it difficult for insects to invade ears, the application of field insecticides, and early harvesting reduce insect infestations in the field. It is urgent to get the harvested corn into dry storage where insecticides or fumigants can be used effectively. Mechanical drying equipment now available makes this possible.

Several fumigant mixtures containing chemicals, such as carbon bisulfide, ethylene dichloride, and carbon tetrachloride, are useful for fumigating corn in tight bins. These fumigants should be handled with the proper precautions because their vapors are harmful to man as well as insects. Details on their use are available from State agricultural offices, county agents, or from the U. S. Department of Agriculture.

Controlling Rats and Mice

Rats and mice sometimes cause heavy damage to corn in cribs. To minimize such losses, cribs having concrete foundations and floors are preferred. If wood floors are used, they should be elevated on posts or piers to give clearances underneath of 2 feet or more. Sheet metal shields should extend over the tops of the piers. Heavy hardware cloth or wire netting firmly attached to the lower side walls and floors will also help keep rats out of cribs.

A number of rodenticides are available that are safe for general use. Others that are dangerous to humans or domestic animals should be obtained and used only by persons trained in handling them.[2]

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[2] For detailed information on controlling rats see U. S. Department of the Interior Conservation Bulletin 19, Rat Proofing Buildings and Premises, and Circular 13, Rat Control Methods.

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